Z. Dt. Ges. Geowiss. (J. Appl. Reg. Geol.), **171 (2)**, p. 99–103, 3 figs.
Published online March 2020

Editorial

A life dedicated to the geosciences – Tribute to Prof. Dr. Karl-Armin Tröger (1931–2019)

The current volume of the ZDGG (Zeitschrift der Deutschen Gesellschaft für Geowissenschaften) "*A life dedicated to the geosciences – Tribute to Prof. Dr. Karl-Armin Tröger (1931–2019)*" is devoted to Prof. Dr. Karl-Armin Tröger who died on 2nd of January 2019 in Freiberg shortly after reaching the blessed age of 87.

Karl-Armin Tröger was a university lecturer and geologist/palaeontologist at the Geological Institute of the Bergakademie Freiberg (BAF, later Technical University Bergakademie Freiberg, TU BAF) until his retirement in 1997. However, with his retirement, he not at all stopped being active but used his newly won freedom from substantial university-related administrative obligations and an extensive teaching load for his beloved geoscience and international travelling. Furthermore, thanks to his robust nature and physical fitness, Karl-Armin Tröger remained alert, energetic and self-determined until the very end.

Karl-Armin Tröger was born on 30th of November 1931 in Melun near Paris and grew up in Plauen and Dresden (Saxony, Germany). In 1950, he applied to study geology at the BAF, which he completed in 1955 with an excellent diploma thesis on sedimentological-palaeontological investigations of the Cretaceous of the Plauenscher Grund in Dresden. The results have been published in the „Jahrbuch des Staatlichen Museums für Mineralogie und Geologie zu Dresden" (Tröger 1955). After completing his studies, Karl-Armin Tröger became a scientific assistant at the Geological Institute of the BAF. He recorded his stratigraphic and tectonic analyses in the lower Palaeozoic sedimentary rocks of the Vogtland as part of his doctoral thesis, which he completed in 1959 at the BAF.

After finishing his doctorate, he worked for two years at the Central Geological Service (Freiberg) as a mapping geologist, cooperating closely with Kurt Pietzsch, one of the most influential Saxonian geologists of the 20th century. In 1961, Karl-Armin Tröger went back to the geological institute at BAF. As part of the oil boom of the 1960s, he worked on the Cretaceous successions in more than 40 exploration wells, with special emphasis on the stratigraphic distribution and palaeobiodiversity of the inoceramid bivalves. By defining various parameters, he put their determination on a quantitative basis and, based on the Saxonian Cretaceous and the sequences in the North German Basin, he erected a stratigraphic framework that allowed a reliable worldwide correlation based on inoceramid bivalve biozones. These detailed stratigraphic-palaeontological investigations and important results became the essential content of his habilitation thesis (Tröger 1967, 1969).

His scientific achievements were particularly appreciated by being affiliated into the Deutsche Akademie der Naturforscher Leopoldina – Nationale Akademie der Wissenschaften (*Academia Leopoldina*) in 1973. From 1975 to 1976, it was possible for Karl-Armin Tröger to conduct research in the Soviet Union (invitation of the Lomonossow University in Moscow). A biostratigraphic scheme for the European part of the Soviet Union based on inoceramid bivalves and a detailed correlation with central European sections were developed by him. In the 1980s, Karl-Armin Tröger resumed to work on the lower Palaeozoic of the Elbe Zone and the Vogtland as part of a project initiated by the "Zentrales Geologisches Institut" (ZGI, Central Geological Institute) on the subject of "Metallogenie Grundgebirge" (Metallogeny in basement rocks). During that period, he also

Fig. 1: Prof. Dr. Karl-Armin Tröger during a students field trip of the TU Bergakademie Freiberg (TU BAF) in the Subhercynian Basin near Benzingerode in 1983 and at his retirement 1997 (photos: courtesy of Ulf Linnemann and TU BAF).

www.schweizerbart.de
DOI: 10.1127/zdgg/2020/0237
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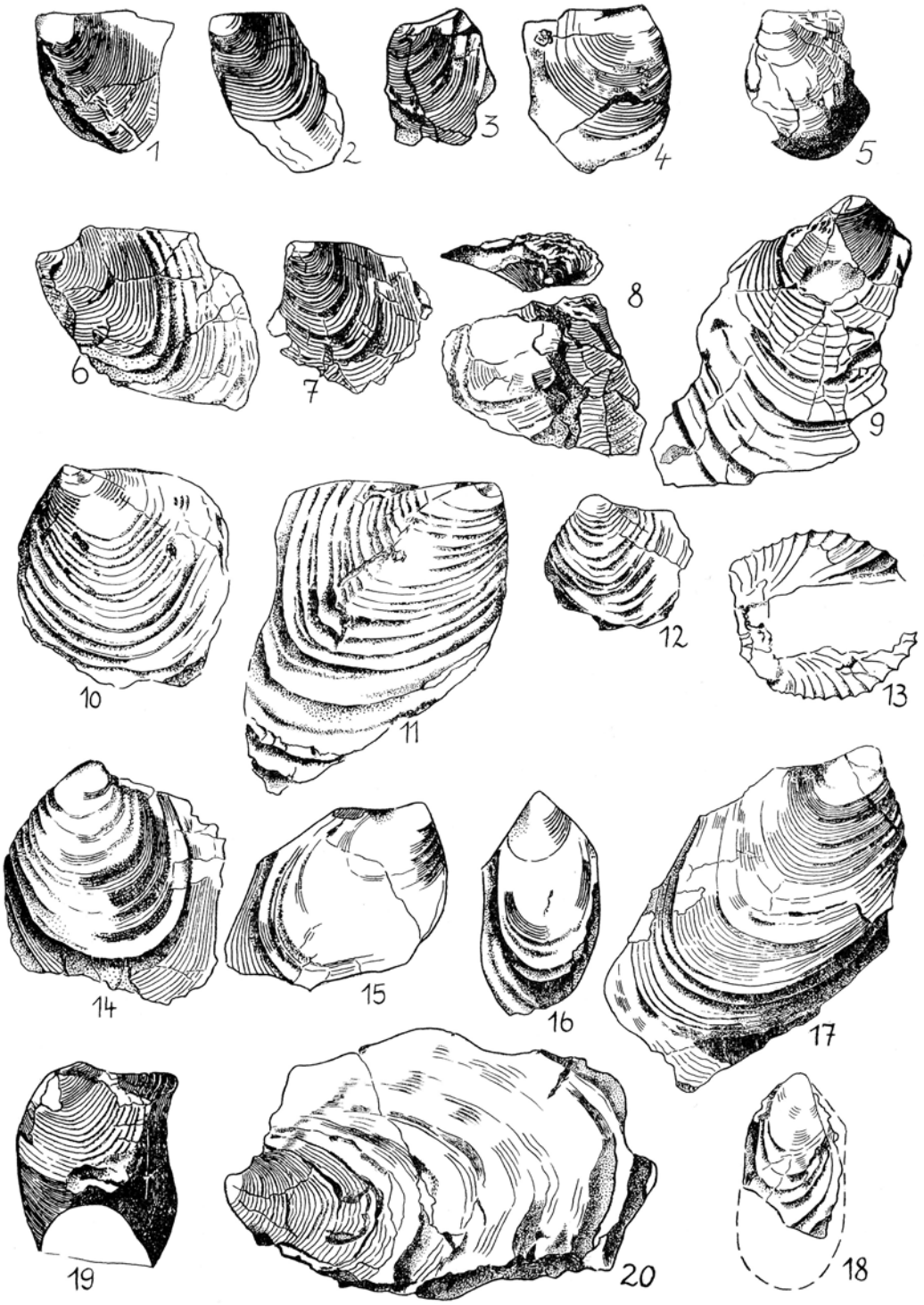

Fig. 2: Reproduction of plate 13 of Tröger (1967) showing upper Turonian to basal Coniacian inoceramids from Saxony and Northern Germany. Karl-Armin Tröger brought hand-drawn illustrations of inoceramid bivalves to perfection and had a considerable talent in visualising geoscientific aspects in general.

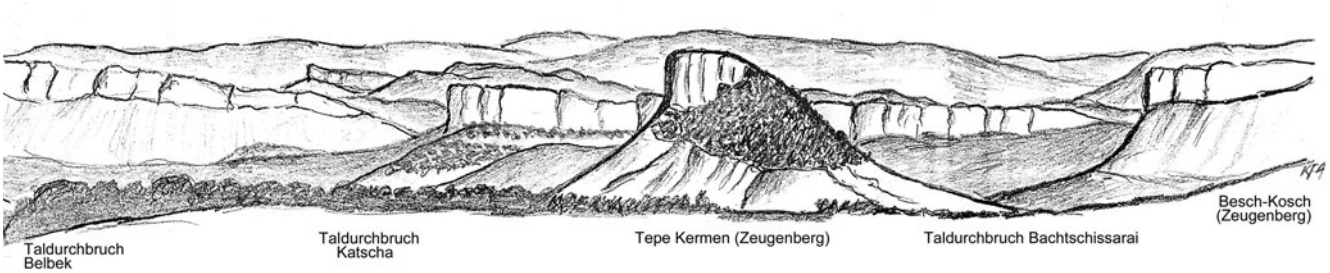

Fig. 3: Panoramic sketch of a landscape in southern Crimea near Jalta studied by Karl-Armin Tröger, taken from his field notebook in order to highlight his great drawing talent (view from Sel-Buchra towards the north: slopes below the escarpments are made of marls and (marly) limestones of Santonian–Campanian age while the cliffs are formed by Maastrichtian–Danian limestones; the hills in the background are composed of Eocene deposits).

published his most well-known textbook, i.e. the "Abriß der Historischen Geologie" (An outline of historical geology; Tröger 1984).

After the political reunion of the two German states, his lectureship at the TU BAF was converted into an extraordinary (a.o.) professorship (1989), and, only somewhat later, he was appointed as a chair (C4 professor) for Dynamic and Historical Geology (1992).

Karl-Armin Tröger is the author of more than 200 scientific publications (only some important of which are mentioned herein for the sake of conciseness) as well as supervisor of 8 dissertations and 36 diploma theses. The TU BAF owes him the concept of one of the didactically best stratigraphic teaching collections in Germany. Karl-Armin Tröger had an outstanding talent as an academic teacher, especially in communicating and visualising geoscientific matters; his precise panel illustrations that he carefully developed during his lectures were legendary. He also re-mapped several geological map-sheets from Saxony. From 1989–2000, he was a voting member of the International Subcommission on Cretaceous Stratigraphy (ISCS) and, in 1996, he brought the 5th International Symposium on the Cretaceous (ISC) to Freiberg. From 1991 until his demise, Karl-Armin Tröger was a member of the German Subcommission for Cretaceous Stratigraphy (SKS), distinguished as an honourable member in 2015. Still in September 2018, he actively participated in the annual field meeting of the SKS. From 1991–2011, Karl-Armin Tröger was also a member of the German Subcommission Riphaean–Silurian (since 2003: Proterozoic–Silurian). During his long-time Cretaceous research he developed a close link with the colleagues and collections of the State Museum of Mineralogy and Geology in Dresden (today Senckenberg Natural History Collections Dresden) where he also published his synoptic catalogue of Late Cretaceous inoceramids in the institutional journal Geologica Saxonica (Tröger 2009). A detailed appraisal of Karl-Armin Tröger on the occasion of his 80th birthday can be found in the Leopoldina-Jahrbuch 2011 (Leopoldina Reihe 3, Jahrgang 57: 241–244).

Concerning the current ZDGG memorial volume, the submitted papers reflect topics that Karl-Armin Tröger was always interested in: his favourite subjects were undoubtedly the lower Palaeozoic and the Cretaceous System. Thus, the papers in this volume deal with (lower) Palaeozoic (two papers) and Cretaceous successions (six papers), covering a variety of geoscientific disciplines such as geochronology, provenance analysis, integrated stratigraphy, sedimentology and (invertebrate) palaeontology. Their sequence of presentation within the memorial volume follows a stratigraphic order.

Palaeozoic sequences are treated in two papers. **Elicki et al.** focus on the zircon geochronology and provenance of upper Proterozoic and lower Palaeozoic rocks of southwestern Jordan. According to the new data based on the U-Pb ages of detrital and magmatic zircon grains, the depositional age of the Neoproterozoic alluvial Saramuj Formation must be extended to the later Ediacaran by about 30 Ma. Consequently, the stratigraphic gap between the Saramuj Formation and the lower Cambrian Salib Formation appears to be significantly shorter. The new data also suggest an intrusion age of 535 ± 12 Ma for the Feinan Granite. The results presented for the Cambro-Ordovician succession come from six different lithostratigraphic units and for the first time, zircon grains were dated from the Cambrian Burj Formation and from the Ordovician Hiswah and Tubayliyat formations. The Cambro-Ordovician zircon populations show a predominance of Neoproterozoic ages with a conspicuous Mesoproterozoic gap. Only the youngest sample from the Upper Ordovician Tubayliyat Formation shows a change (i.e. depletion in Neoproterozoic and an increase in late Mesoproterozoic and Palaeoproterozoic zircon ages), suggesting a sourcing from increasingly deeper erosional levels in the basement rocks of the adjacent Arabian-Nubian Shield. Finally, the authors introduce a revised lithostratigraphic classification for the Ordovician to Silurian rocks in southern Jordan, also incorporating published data.

Zieger et al. deal with the geochronological history of the Hohnsdorf Crystalline Complex, a part of the complex geological puzzle of the Mid-German Crystalline Rise. The authors present the first isotopic LA-ICP-MS zircon and Lu-

Hf data from the Hohnsdorf Crystalline Complex based on the analysis of rocks from drill cores. Paragneisses show a strong Gondwana affinity with a main age cluster ranging from c. 0.5–0.75 Ga and a minor age cluster ranging from c. 1.6–2.3 Ga, suggesting that sedimentation of the protoliths took place at the passive margin of Gondwana. Early Carboniferous metamorphic zircon ages of c. 350 Ma indicate an overprint in the course of the closure of the Rheic Ocean. Orthogneisses provided Carboniferous ages of 326 ± 3 Ma and 325 ± 2 Ma, respectively. Carboniferous (latest Mississippian) felsic volcanism and Mesoproterozoic T_{DM} ages are interpreted to represent a phase of pronounced magmatic activity related to a change in subduction direction from NW to SE. The authors conclude that the Hohnsdorf Crystalline Complex is so far the easternmost part of the Mid-German Crystalline Rise containing metasedimentary rocks of Gondwana affinity and Baltica-derived granitoids.

The Cretaceous System was always in the focus of Karl-Armin Tröger's research, starting with his diploma thesis in 1955, continued with his influential research on inoceramid palaeontology, biostratigraphy and palaeobiogeography during his habilitation in the late 1960th, and persisting into his latest productive phase (e.g. Tröger 2015, 2017). This persistent temporal focus is also well-reflected in the range of Cretaceous papers submitted to this ZDGG special volume, covering among different stratigraphic, sedimentological and palaeontological topics also two contributions on inoceramid palaeontology and biostratigraphy.

In their biostratigraphic-palaeontological study, **Lehmann et al.** focus on the Aptian-Albian boundary interval in Tunisia. The identifications of certain ammonite finds from the Aptian-Albian boundary interval of the type locality of the Serdj Formation at Djebel Serdj in north-central Tunisia are revised and their biostratigraphic significance is discussed. As a result, the discussed part of the Djebel Serdj section is somewhat younger than previously thought. Furthermore, from this critical interval, a single belemnite find is described and identified as *Hibolithes* cf. *obtusirostris* (Pavlow in Pavlow & Lamplugh, 1891). This record represents the youngest occurrence of the genus from the Tethys, hitherto assigned to the early Barremian. The new proof is also of considerable palaeobiogeographic interest since *Hibolithes* is originally a Tethyan genus, which migrated early into the Boreal seas and from there later on back again into the Tethys Ocean.

Applying an integrated approach, **Erbacher et al.** describe the chemostratigraphy and stratigraphic distribution of keeled planktonic foraminifera in the Cenomanian of the North German Basin. The authors use micropalaeontologic data as well as bulk carbonate carbon and oxygen isotope analyses of two core sections near the centre of basin in order to unravel the discontinuous Cenomanian record of keeled planktonic foraminifera in Boreal epicontinental basins. They show that during the early and (early) middle Cenomanian, keeled praeglobotruncanids and rotaliporids exclusively appeared only during three stratigraphic intervals while after the Mid-Cenomanian Event (MCE) I, keeled planktonic foraminifera were continuously present. The authors relate the presence/absence of keeled planktonic foraminifera in the North German Basin to sea-level changes and according environmental variations in the epicontinental basin.

Based on comprehensive new investigations, **Niebuhr et al.** revise the stratigraphy of the almost 1,000 m thick marine Upper Cretaceous succession of the Elbtal Group in the Zittauer Sandsteingebirge (Germany and Czechia), also appreciating and carefully reappraising existing data. The upper Cenomanian to lower mid-Turonian strata (Oberhäslich and Pennrich formations as well as the Weißbach Member of the Oybin Formation) are fairly similar in lithological development and thickness to the contemporaneous units exposed in the Elbe Valley, the type area of the Elbtal Group. This pattern changes with a strong pulse of inversion-tectonic uplift of the Lusatian Massif in the northeast during the early middle to early late Turonian when more than 300 m of coarse-grained siliciclastics of the Straßberg Member of the Oybin Formation accumulated immediately south of the (later) Lusatian Thrust Fault. An intermittent abatement of inversion-tectonic activity and/or superposition of continued uplift by a strong eustatic sea-level rise are mirrored by the fine-grained, calcareous mid-upper Turonian Lückendorf Formation. The overlying Waltersdorf Formation (upper upper Turonian to upper lower Coniacian), characterised by particularly high sedimentation rates, indicates resumption of strong subsidence in front of the rising Lusatian Massif. The onset of marl-dominated sedimentation in the middle Coniacian, known from many Central European Cretaceous basins, marks the final maturation of the marginal troughs in front of the active thrust faults.

Remaining regionally located in the Elbtal Group, **Schönfeld & Voigt** analyse stratigraphic architectures and sedimentary facies of the upper Turonian–lower Coniacian Schrammstein Formation in southern Saxony, Germany, and infer its palaeobathymetry and sequence stratigraphic significance. For their study, the authors analysed the geometry of sedimentary bodies, inventory of sedimentary structures, and grain size distribution of the sandstone members d and e as well as of the boundary horizons γ_3 and δ_2 at the Schrammstein and Affensteine rock massifs close to Schmilka. The sedimentary facies indicates a shoaling from lower to upper shoreface and beach environments, from the massive sandstones to the basal boundary horizons and back, while the geometry of the sandstones reveals that they are composed of stacked fan lobes with a diameter of a few hundred metres that had their sediment source to the north. The authors conclude that synsedimentary tectonics along the Lausitz Thrust Fault had only a minor influence on the sediment accumulation and that mainly sea-level fluctuations shaped the sedimentary bodies and controlled the deposition of the boundary horizons that today form important marker horizons for (sequence) stratigraphic correlation.

In their global round trip, **Wiese et al.** detail the stratigraphy and palaeobiogeographic distribution of *Mytiloides incertus* (Jimbo, 1894) and propose a revised inoceramid bivalve biozonation for the central European upper Turonian (Upper Cretaceous). The substage is subdivided into five inoceramid bivalve biozones, i.e. the *Inoceramus perplexus*,

Mytiloides striatoconcentricus, *M. labiatoidiformis*, *M. scupini* and *Cremnoceramus waltersdorfensis waltersdorfensis* interval zones (IZ). According to integrated stratigraphic calibration, *M. incertus* first appears in the *M. striatoconcentricus* IZ and has its last occurrence in the (lower) *M. scupini* IZ. An acme of the species in the terminal *M. labiatoidiformis* IZ appears to be isochronous between European basins and the United States Western Interior Basin. The co-occurrence of *M. incertus* with other central European species (*I. perplexus*, *M. striatoconcentricus*) marks the end of an endemic phase among the Western Interior inoceramid faunas.

Finally, **Walaszczyk & Todes** revise *Inoceramus proximus* and other inoceramid species of the North American 19th century palaeontologist Michael Tuomey from the Cretaceous of Alabama and Mississippi. For their systematic study, the authors located the original material, long regarded as lost during the American Civil War, in the Museum of the Geological Survey of Alabama and the Alabama Natural History Museum in Tuscaloosa. The following taxa are illustrated, taxonomically described and systematically discussed: *Platyceramus proximus* (Toumey, 1856), *Platyceramus biformis* (Tuomey, 1856) and *Cordiceramus inflatus* (Tuomey, 1856); for *P. proximus*, a lectotype is designated and *Inoceramus triangularis* Tuomey, 1856 is regarded as a younger subjective synonym of this species. All inoceramid bivalve species described therein represent morphotypes that are distributed widely in the Santonian–Campanian boundary interval of the Euramerican Biogeographic Region and beyond.

As outlined above, the papers in this special issue of the ZDGG are all linked to the main areas of interest of Karl-Armin Tröger. Of course, we cannot reflect the complete, very broad spectrum of his scientific interests but we are sure that he certainly would have enjoyed reading all the papers included herein. We deeply regret the loss of a highly esteemed colleague and an exceptionally gifted academic teacher who was scientifically active into old age. We will lack his advice, expertise and friendship, and we will always keep an honourable memory of Prof. Dr. Karl-Armin Tröger.

Markus Wilmsen, Dresden
Thomas Voigt, Jena
Ulf Linnemann, Dresden

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